DETERMINATION OF THE INFLIGHT SPECTRAL CALIBRATION OF AVIRIS USING ATMOSPHERIC ABSORPTION FEATURES

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1. INFLIGHT SPECTRAL CALIBRATION

Spectral calibration of the Airborne Visible/Infrared Imaging Spectrometer (AVIRIS) as data are acquired inflight is essential to quantitative analysis of the measured upwelling spectral radiance (Green 1995). In each spectrum measured by AVIRIS inflight there are numerous atmospheric gas absorption bands that drive this requirement for accurate spectral calibration. If the surface and atmospheric properties are measured independently, these atmospheric absorption bands may be used to deduce the inflight spectral calibration of an imaging spectrometer (Conel, et al., 1988, Green, et al., 1988,1993).

Both the surface and atmospheric characteristics were measured for a calibration target during an inflight calibration experiment held at Lunar Lake, Nevada on April 5, 1994 (Green, et al., 1995). This paper uses upwelling spectral radiance predicted for the calibration target with the MODTRAN radiative transfer code (Berk, et al., 1989) to validate the spectral calibration of AVIRIS inflight.

Surface reflectance, atmospheric optical depths and water vapor measurements were used to constrain the MODTRAN and predict at high spectral resolution the upwelling radiance at AVI IUS over the inflight calibration target (Figure 1). To compare this MODTRAN radiance with AVIRIS radiance, MODTRAN must be convoluted to the AVIRIS spectral channels (Figure 2). As an example this convolution is shown from 700 to 1250 nnt (Figure 2). The radiance reported by the AVIRIS channels in the vicinity of the atmospheric absorption is strongly dependent of the laboratory calibrated (Chrien, et al., 1990) spectral wavelength position of each AVIRIS channel. An algorithm was developed in 1988 to derive the inflight spectral calibration of AVIRIS using these atmospheric absorption bands (Green, et al., 1988). This algorithm optimizes the agreement between the AVIRIS measured spectrum and the MODTRAN predicted spectrum across a single absorption band by varying the AVI RIS channel spectral calibration characteristics. Results for this algorithm applied to the April 1994 calibration experiment data are given (Table 1). The spectral locations of the atmospheric band, the band source, the AVIRIS spectrometer affected, the AVIRIS channel spectral shift from laboratory calibration, and the confidence level are given.

In this analysis none of the derived inflight spectral exceeded the uncertainty of the algorithm. The uncertainty or confidence level is set breed on the spectral contrast of the absorption band, Contrasts of the absorption band minim to continua of greater than 25 percent are given a confidence of+- 1.0 run. Bands with less than 25 percent contrast are given a -E- 2.0 nm confidence. Levels of 1.0 and 2.0 run are estimated based on confidence in the MODTRAN model, AVIRIS radiometric stability and in situ measurement. These confidence levels are supported in the algorithm results by tJre discrepancy for pairs of absorption bands in the same spectrometer. For example, the strong C0^{2} bands at 2020 and 2060 nm give differing results of 0.5 nm and the results for the week C02 bands at 1580 and 1610 differ by 2.1 nm. These data show that the inflight spectral calibration had not changed with respect to the laboratory spectral calibration at the level of confidence in the algorithm.

Table 1. AVI RIS Inflight Spectral Calibration

Wave length run	Source	Spectra meter	Shift from Lab nm	Confidence nm
430	solar	A	-0.3	+ -2.0
520	solar	A	+0.4	+ -2.0
620	H20	A	-0.4	+ -2.0
650	H20	A	+1.2	+-2.0
690	H20	B	-0.6	+-2.0
730	H?O	B	+0.4	+-2.0
760	0 2	B	-0.7	+-1.0
820	H20	B	+0.3	+-2.0
940	H20	B	-0.5	+-1.0
1140	H20	B	+0.0	+-1.0

1260	02	c	+0.0	+-2.0
1470	H20	c	-0.2	+-2.0
1580	C02	c	+1,2	+-2.0
1610	C02	c	-0.9	+-2.0
2020	C02	D	-0.3	+-1.0
2060	C02	D	-0.8	+-1 .0
2350	CH4	D	+0.2	+-2.0
2380	CH4	D	-0.8	+ -2.0
2420	CH4	D	+0.0	+-2.0
2460	CH4	D	-0.1	+-2.0

2. ACKNOWLEDGMENTS

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3. REFERENCES

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4. FIGURES

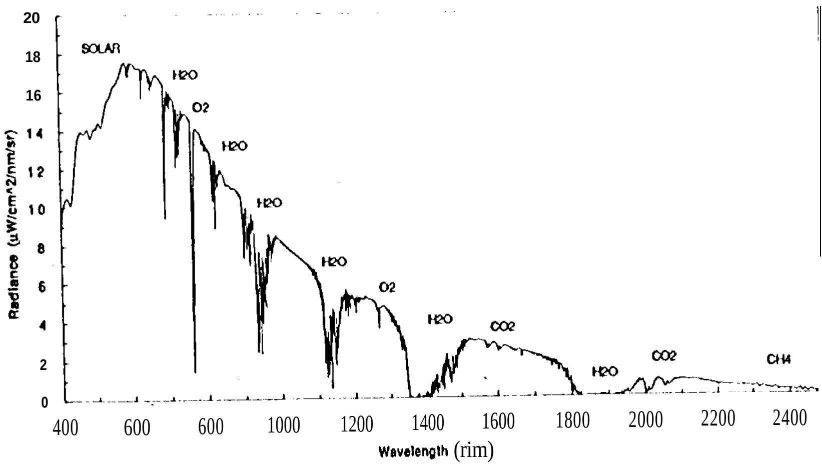

Figure 1. **Upwelling** spectral radiance predicted by MODTRAN for the **AVIRIS** overflight of Lunar **Lake,** NV on-April **5, 1994.**

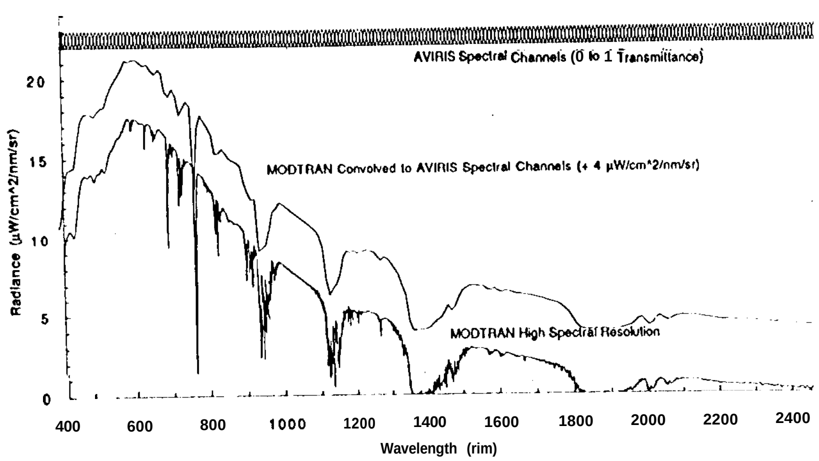

Figure 2. Convolution of **MODTRAN** to **AVIRIS spectral** channel Characteristics.

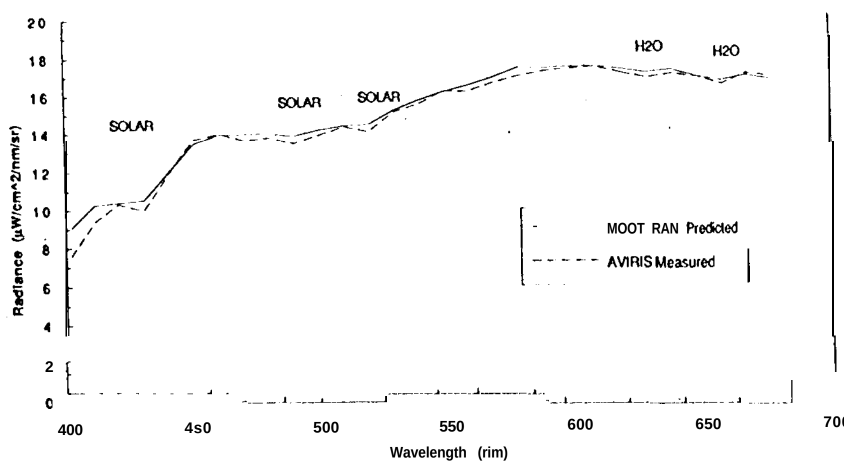

Figure 3. **AVIRIS** measure-d and MODTRAN predicted radiance for the A spectrometer based on the laboratory **spectral** calibration.

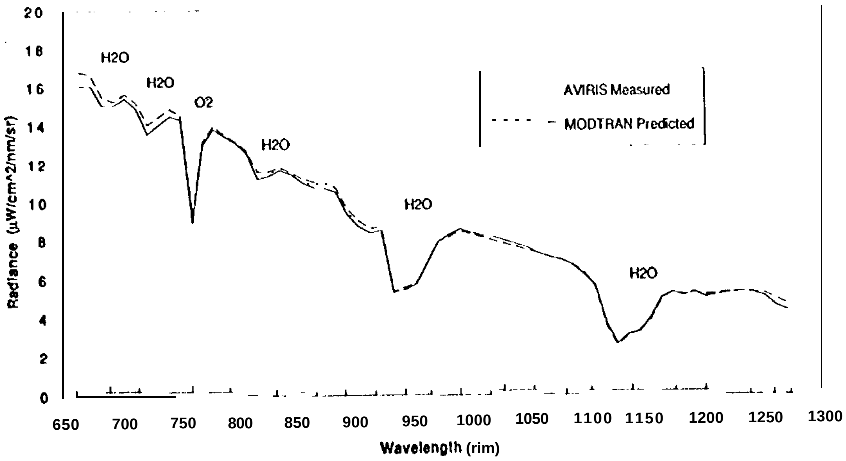

Figure 4. **AVIRIS measured** and **MODTRAN** predicted radiance for the B spectrometer based on the **laboratory** spectral calibration.

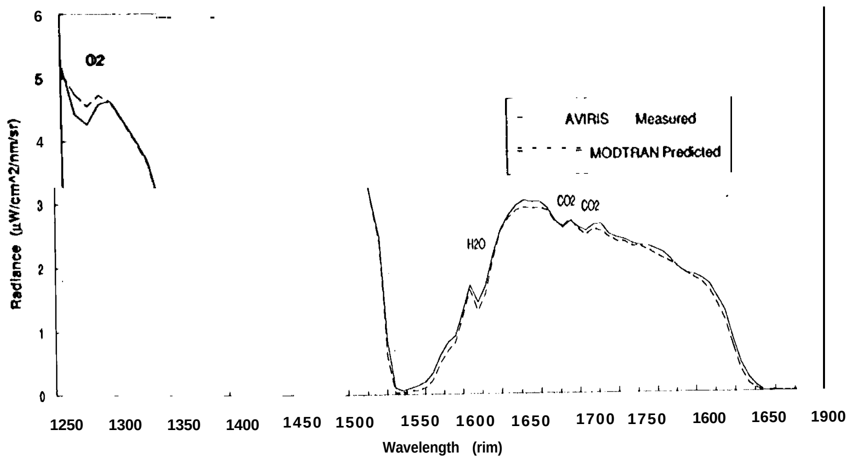

Figure 5. **AVIRIS** measured and MODTRAN **predicted** radiance for the C spectrometer **based** on the laboratory spectral calibration.

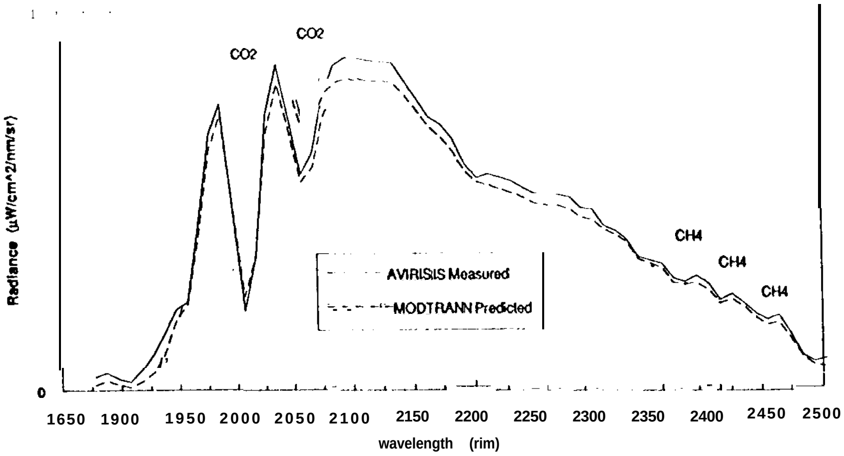

Figure 6. **AVIRIS** measured and **MODTRAN predicted** radiance for the D spectrometer based on the laboratory spectral calibration.